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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/839,636	04/20/2001	Mohammad H.S. Amin	M-8915-2C US	2156
24251	7590	10/03/2003	EXAMINER	
SKJERVEN MORRILL LLP 25 METRO DRIVE SUITE 700 SAN JOSE, CA 95110			WILSON, SCOTT R	
			ART UNIT	PAPER NUMBER
			2826	

DATE MAILED: 10/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	Application N .	Applicant(s)	
	09/839,636	AMIN ET AL.	
	Examiner	Art Unit	
	Scott R. Wilson	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 05 August 2002.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-56 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1, 14-24, 32-36, 40, 49, 53 and 56 is/are rejected.
- 7) ☒ Claim(s) 2-13, 25-31, 37-39, 41-48, 50-52, 54 and 55 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 April 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

#### Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

#### Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                             | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____  |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                    | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

### *Specification*

The disclosure is objected to because of the following informalities: On page 13, lines 22 and 23, "12" should be replaced by "13". On page 18, line 25, " $W_{2A}$ " should be replaced by " $W_2$ ".

Appropriate correction is required.

### *Claim Rejections - 35 USC § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in–

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

Claims 1, 20-24, 32-36 and 49 are rejected under 35 U.S.C. 102(e) as being anticipated by Amin et al.. As to claim 1, Amin et al., Figure 9, discloses a qubit system comprising a qubit (paragraph 0050), the qubit including a multi-terminal junction, comprising the intersection of the SQUID magnetometer (702) leads with the voltmeter (704) leads, coupled to a superconducting loop, the SQUID (702), the superconducting loop having a phase shift (Abstract), and a controller coupled to the qubit, embodied as the current device (703).

As to claim 20, Amin et al, paragraph 0012, discloses that the superconducting loop may be formed with a junction between two d-wave superconducting materials with a grain boundary between them.

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As to claim 21, Amin et al., Figure 9, discloses that the controller (703) is coupled to the terminals of the multi-terminal junction to provide transport current through the multi-terminal junction.

As to claim 22, Amin et al., Figure 9, discloses that the controller (703) can pass current symmetrically through the multi-terminal junction.

As to claim 23, Amin et al., paragraph 0051, discloses that the controller (703) can apply a current pulse.

As to claim 24, Amin et al., paragraph 0051, discloses that the controller (703) can apply a constant current.

As to claim 32, Amin et al, Figure 9, discloses that an external magnetic field can be applied to the superconducting loop.

As to claims 33 and 34, Amin et al. discloses a dc-SQUID device, in which the phase necessarily changes in response to an external magnetic field, in order to operate. The scope of claims 33 and 34 is within the scope of a phase change in the superconducting loop in response to a changing external magnetic field.

As to claim 35, Amin et al., paragraph 0051, discloses that the voltmeter (704) may be used for reading a quantum state of the qubit.

As to claim 36, Amin et al., paragraph 0051, discloses that the voltmeter (704) may be a radio-frequency single electron transistor electrometer.

As to claim 49, Amin et al., Figure 9, discloses that the multi-terminal junction is a four-terminal junction.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 14-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Amin et al. in view of Rose et al.. As to claim 14, Amin et al. discloses the invention of claim 1, as described above. Amin et al. does not disclose expressly the phase shift produced by a ferromagnetic junction. Rose et al., paragraph 0043, discloses a ferromagnetic junction used as a phase shift device in a superconducting device. At the time of invention, it would have been obvious to a person of ordinary skill in the art to use a ferromagnetic junction in the superconducting loop. The motivation for doing so would have been to enable an additional method of controlling the phase shift in the junction, by for example, the junction geometry (paragraph 0043). Therefore, it would have been obvious to combine Rose et al. with Amin et al. to obtain the invention as specified in claim 14.

As to claim 15, Rose et al., Figure 1G and paragraph 0043, discloses that the ferromagnetic junction is formed between two superconducting terminals (210) and (211), which are connected to a superconducting loop.

As to claim 16, Rose et al., paragraph 0043, discloses that the first and second portion are each s-wave superconducting material.

As to claim 17, Rose et al., paragraph 0043, discloses that the s-wave superconducting material may be formed from niobium.

As to claim 18, Rose et al., paragraph 0043, discloses that the junction may be formed from an alloy of copper and nickel sandwiched between the first and second portions.

As to claim 19, Rose et al., paragraph 0043, discloses that the junction may be formed by implantation of a ferromagnetic substance into the superconducting junction between the first and second portions.

Claim 40 is rejected under 35 U.S.C. 103(a) as being unpatentable over Amin et al. in view of applicants prior art. Amin et al. discloses the invention of claim 1, as described above. Amin et al. does not disclose expressly a second qubit coupled to a first qubit through an entanglement junction. Applicants prior art (page 2, line 25) discloses the entanglement of N qubits, which is within the scope of applicants coupling of two qubits through an entanglement junction. At the time of invention, it would have been obvious to a person of ordinary skill in the art to entangle two qubits. The motivation for doing

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so would have been to enable a quantum computation. Therefore, it would have been obvious to combine applicants prior art with Amin et al. to obtain the invention as specified in claim 40.

Claim 53 is rejected under 35 U.S.C. 103(a) as being unpatentable over Amin et al. in view of applicants prior art. Amin et al. discloses the invention of claim 1, as described above. Amin et al. does not disclose expressly the qubit coupled to other qubits to form a qubit array. Applicants prior art (page 2, line 25) discloses the entanglement of N qubits, which is within the scope of applicants qubit coupled to other qubits to form a qubit array. At the time of invention, it would have been obvious to a person of ordinary skill in the art to form the qubit coupled to other qubits to form a qubit array. The motivation for doing so would have been to enable a quantum computation. Therefore, it would have been obvious to combine applicants prior art with Amin et al. to obtain the invention as specified in claim 53.

Claim 56 is rejected under 35 U.S.C. 103(a) as being unpatentable over Amin et al. in view of applicants prior art. Amin et al. discloses the invention of claim 1, as described above. Amin et al. does not disclose expressly the qubit coupled to other qubits to form a random number generator. Applicants prior art (page 2, lines 19-21) discloses that "quantum computers (or even a smaller scale device such as a quantum repeater) could enable absolutely safe communication channels where a message, in principle, cannot be intercepted without being destroyed in the process". This prior art described quantum encryption, which uses qubits combined together into random number generators. At the time of invention, it would have been obvious to a person of ordinary skill in the art to form the qubit coupled to other qubits to form a random number generator. The motivation for doing so would have been to enable a quantum encryption. Therefore, it would have been obvious to combine applicants prior art with Amin et al. to obtain the invention as specified in claim 56.

#### ***Allowable Subject Matter***

Claims 2-13, 25-31, 37-39, 41-48, 50-52, 54 and 55 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

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As to claim 2, no prior art discloses a multi-terminal junction of a qubit which includes a constriction junction.

As to claims 3-5, no prior art discloses a multi-terminal junction of a qubit which includes tunnel junctions.

As to claims 6 and 7, no prior art discloses a multi-terminal junction of a qubit which includes a two-dimensional electron gas structure.

As to claim 8, no prior art discloses a multi-terminal junction of a qubit which includes an S-N-D-N-S junction.

As to claims 9-13, no prior art discloses a multi-terminal junction of a qubit which includes an S-N-D-N-S junction in which the d-wave superconducting material comprises two portions with a phase-shifting grain boundary between them.

As to claim 25, no prior art discloses the adjustment of the tunneling frequency of one qubit in an array of qubits by varying the constant current supplied to a multi-terminal junction.

As to claims 26-31, no prior art discloses a current source passing current asymmetrically through a multi-terminal junction of a qubit.

As to claims 37-39, no prior art discloses a quantum state readout of a multi-terminal junction qubit comprised of either a magnetic force microscope, a superconducting loop or a Hall probe.

As to claim 41, no prior art discloses a multi-terminal junction qubit coupled to another multi-terminal junction by an entanglement junction which itself includes a multi-terminal junction and a plate. Claims 42-47 further limit the allowable subject matter of claim 41.

As to claims 48, 50, 51 and 52, no prior art discloses a multi-terminal qubit in which the multi-terminal junction is a 3, 5, 6, or more than 6 terminal junction, respectively.

As to claims 54 and 55, no prior art discloses a multi-terminal qubit in which the multi-terminal junction of the qubit is shared with other qubits of the qubit array, nor that the multi-terminal junction is coupled to other multi-terminal junctions that are not included in other qubits.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Scott R. Wilson whose telephone number is 703-308-6557. The examiner can normally be reached on M-F 8:30 - 4:30 Eastern.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on 703-308-6601. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-1782.

srw  
September 28, 2003

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